

AFE 76s2 Report

Derivation of Radar Altimeter Interference Tolerance Masks

**Volume I: Introduction,
Test Procedures, and
Fundamental Test Results**

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3.2.2 1000 Feet AGL

3.2.2.1 Summary

Table 3-9: UC1 1000' AGL Test Conditions

Source	Rationale	Signal Type	Characteristics	Setting
VSG	5G Fundamental OOB	OFDM	100 MHz TM1.1 centered at 3750 MHz, 3850 MHz, 3930 MHz	Power Sweep
VCOs 1-2	Own-ship multiplex installation	FMCW	CF: 4300 MHz BW/Sweep Rate per AUT	ON
VCOs 3-16	WCLS – other aircraft	FMCW		OFF

Table 3-10: UC1 1000' AGL OOB Fundamental Emissions Break Points

Altimeter	1000 ft, Own-Ship VCOs											
	3750 MHz				3850 MHz				3930 MHz			
	ME	1%	99%	NCD	ME	1%	99%	NCD	ME	1%	99%	NCD
F	-20 dBm	-20 dBm	NB	-19 dBm	-21 dBm	-21 dBm	NB	NB	-23 dBm	-24 dBm	NB	NB
L	NB	NB	NB	NB	NB	NB	NB	NB	NB	NB	NB	NB
T	NB	NB	NB	NB	NB	NB	NB	NB	NB	NB	NB	NB
X	NB	NB	NB	NB	-8 dBm*	-7 dBm	NB	-2 dBm	-14 dBm	-13 dBm	NB	-8 dBm
Y	-15 dBm	-15 dBm	NB	-15 dBm	-14 dBm	-14 dBm	NB	-14 dBm	-17 dBm	-17 dBm	NB	-17 dBm
ITM	-26 dBm				-27 dBm				-30 dBm			
PSD	-46 dBm/MHz				-47 dBm/MHz				-50 dBm/MHz			

* – Indicates engineering judgement was applied to determine break point

3.2.2.2 Altimeter F

Table 3-11: UC1 RA-F 1000' AGL OOB Fundamental Emissions Break Point Summary

Center Frequency	Plot	Comments
3750 MHz	Time History Figure 3-37	Shows magnitude of change in measured height over time for increasing interference power levels.
	Statistics Figure 3-38 Figure 3-39	Mean error exceeds the $\pm 0.5\%$ criterion threshold at -20 dBm. 1 st percentile measured height is less than the -2% criterion threshold at -20 dBm. An NCD occurs at -19 dBm.
3850 MHz	Time History Figure 3-40	Shows magnitude of change in measured height over time for increasing interference power levels.
	Statistics Figure 3-41 Figure 3-42	Mean error exceeds the $\pm 0.5\%$ criterion threshold at -21 dBm. 1 st percentile measured height is less than the -2% criterion threshold at -21 dBm.
3930 MHz	Time History Figure 3-43	Shows magnitude of change in measured height over time for increasing interference power levels.
	Statistics Figure 3-44 Figure 3-45	1 st percentile measured height is less than the -2% criterion threshold at -24 dBm. Mean error exceeds the $\pm 0.5\%$ criterion threshold at -23 dBm.

Center Frequency = 3750 MHz

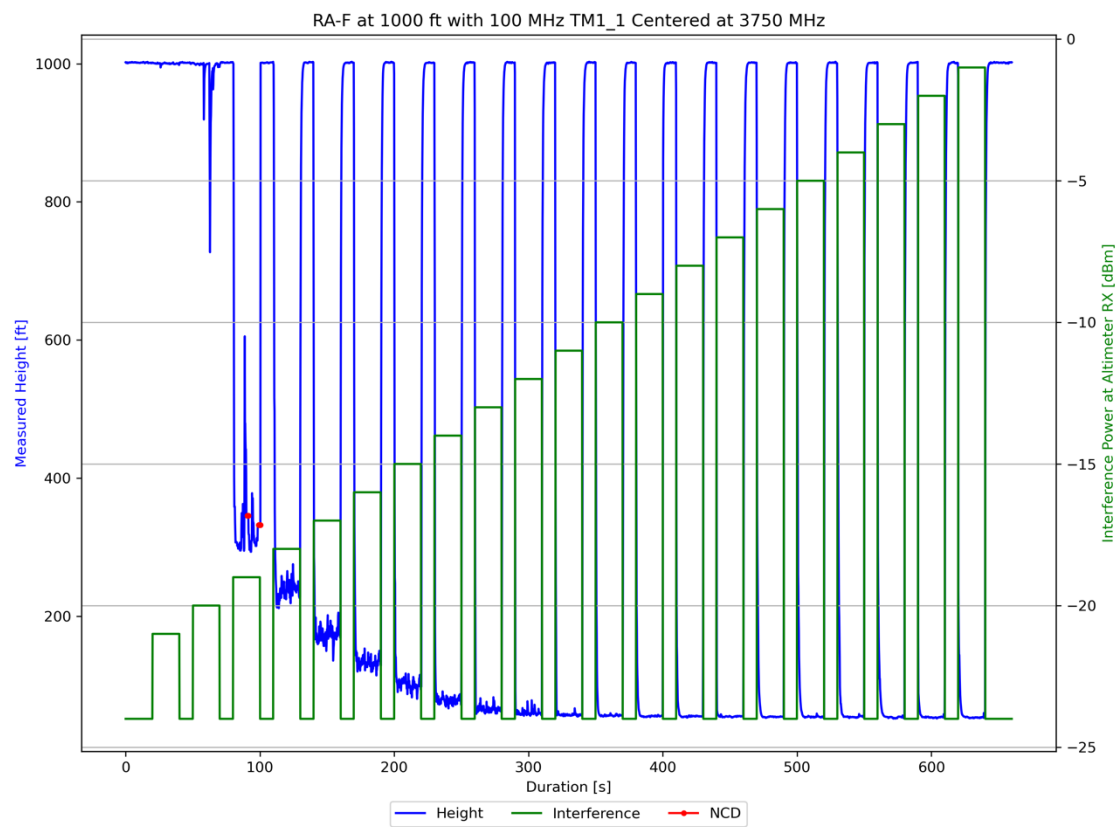


Figure 3-37: UC1 RA-F 1000' AGL Time History with TM1.1 at 3750 MHz

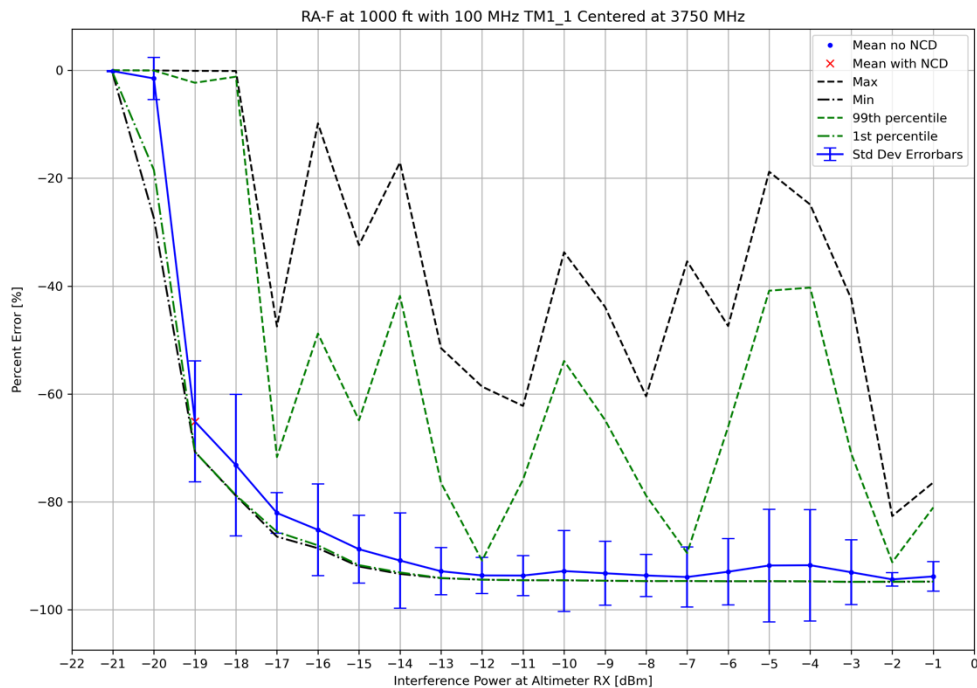


Figure 3-38: UC1 RA-F 1000' AGL Statistics with TM1.1 at 3750 MHz – Zoomed Out

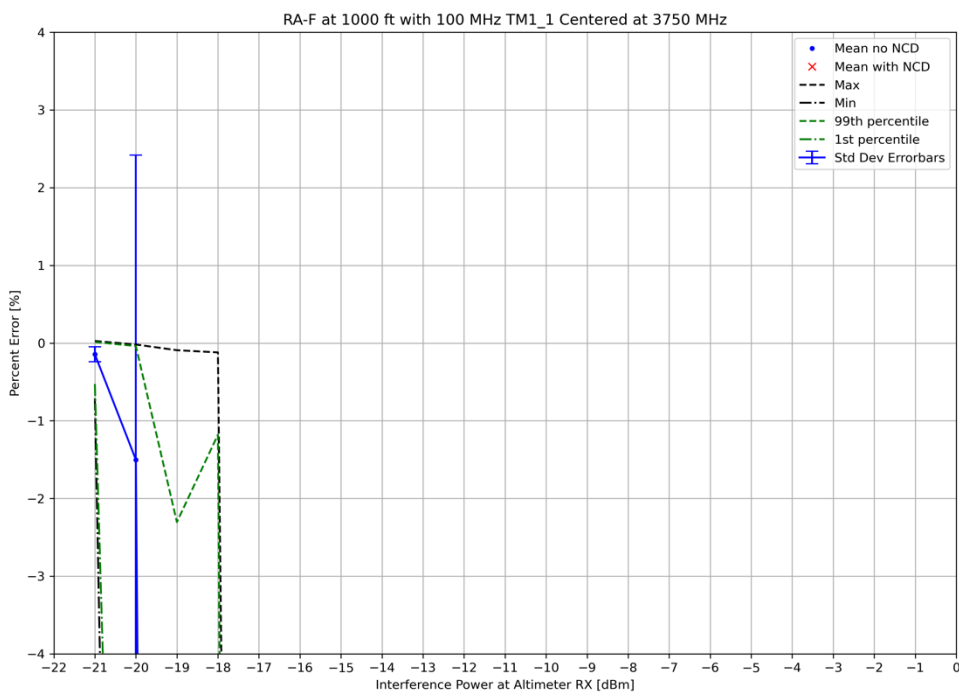


Figure 3-39: UC1 RA-F 1000' AGL Statistics with TM1.1 at 3750 MHz – Zoomed In

Center Frequency = 3850 MHz

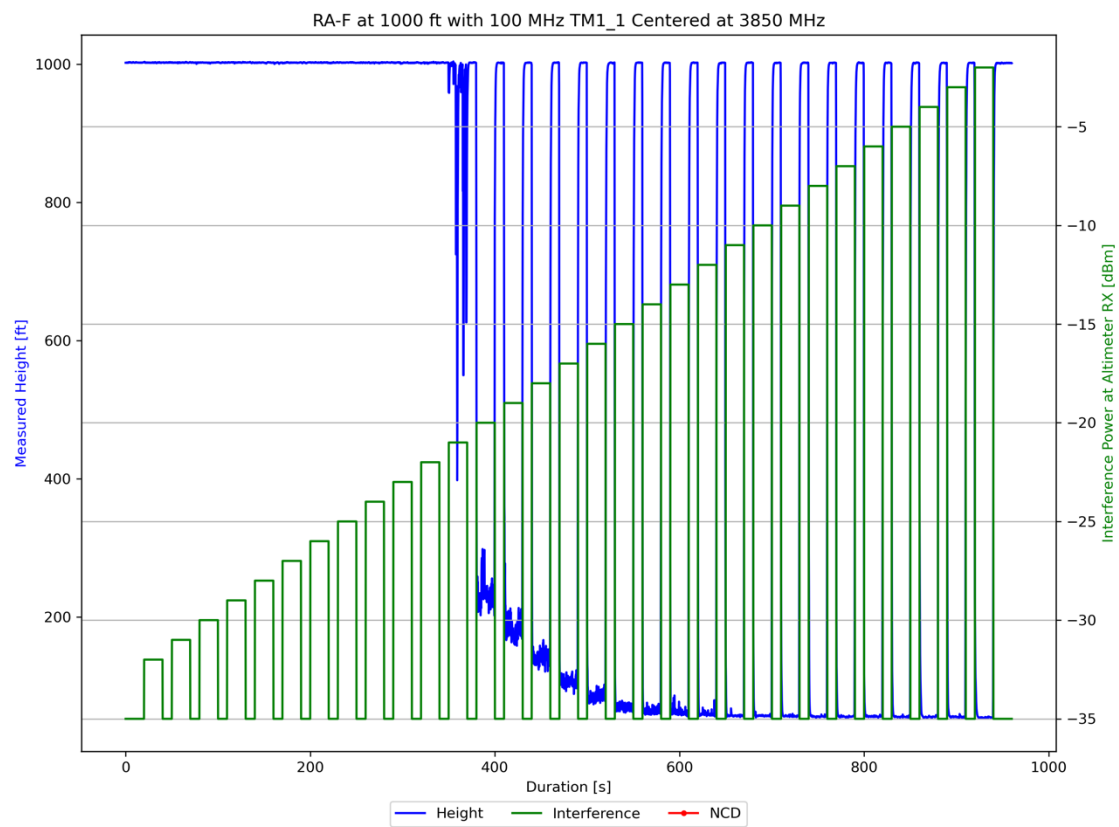


Figure 3-40: UC1 RA-F 1000' AGL Time History with TM1.1 at 3850 MHz

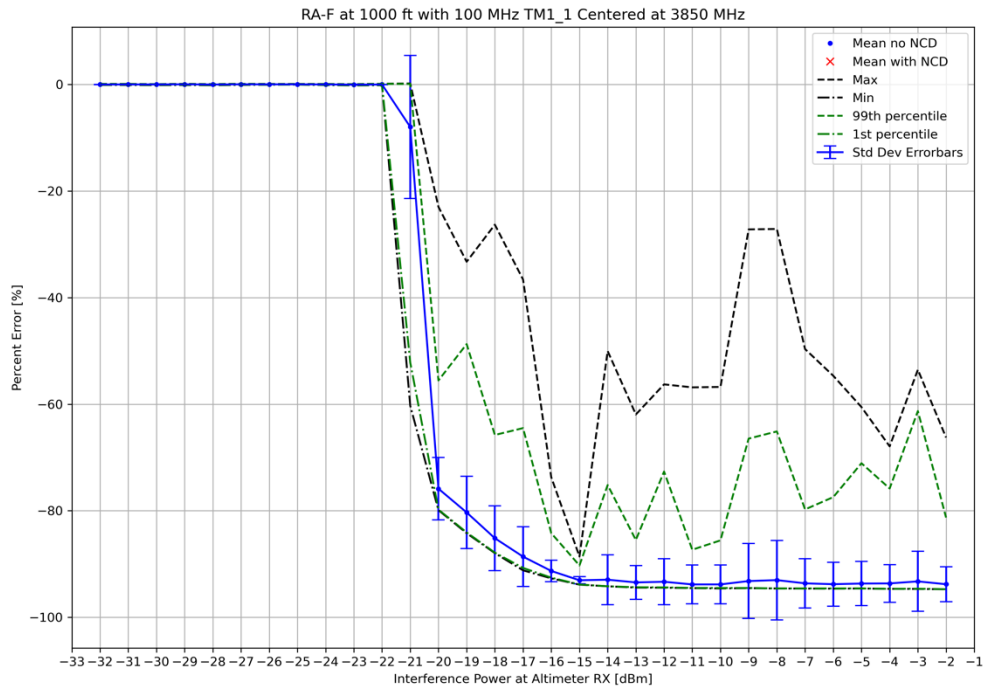


Figure 3-41: UC1 RA-F 1000' AGL Statistics with TM1.1 at 3850 MHz – Zoomed Out

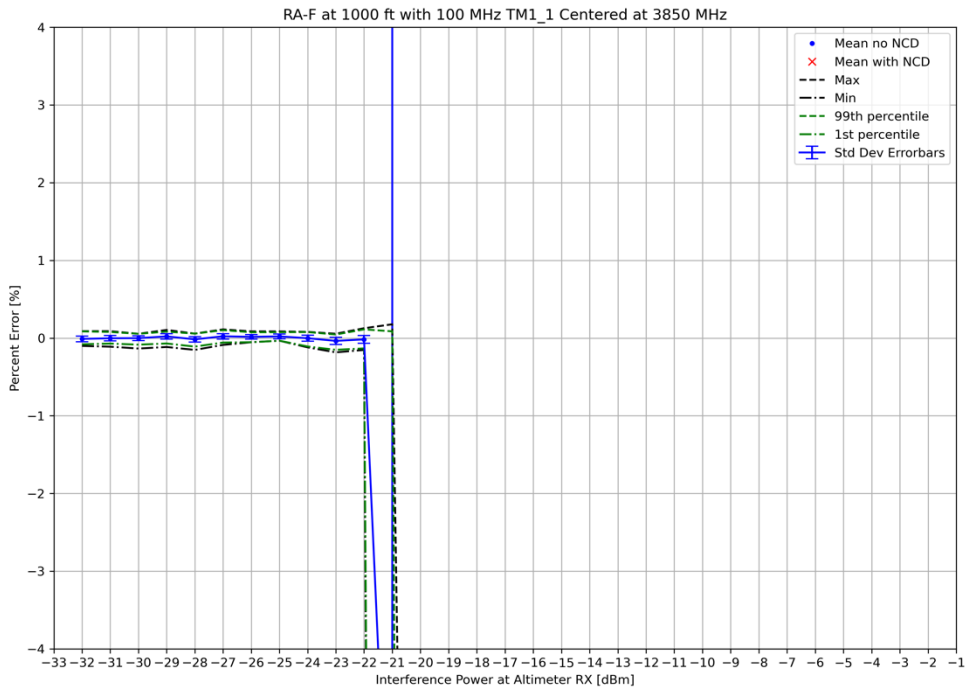


Figure 3-42: UC1 RA-F 1000' AGL Statistics with TM1.1 at 3850 MHz – Zoomed In

Center Frequency = 3930 MHz

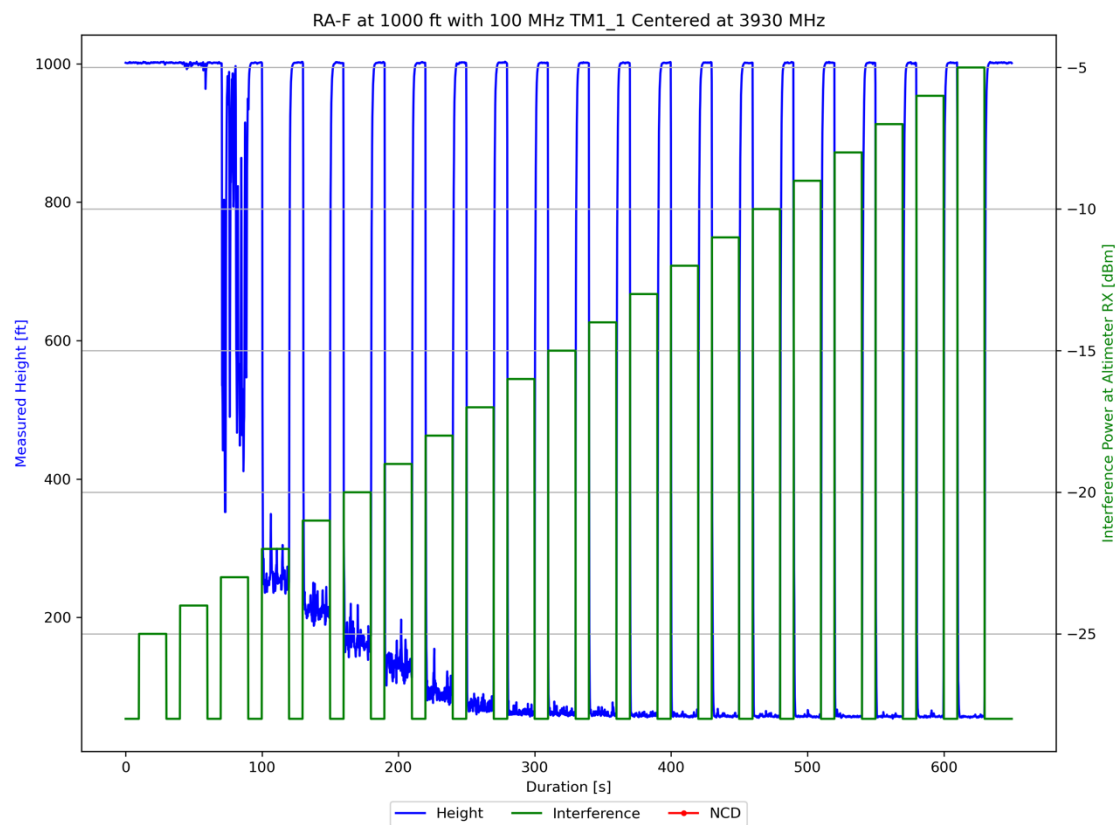


Figure 3-43: UC1 RA-F 1000' AGL Time History with TM1.1 at 3930 MHz

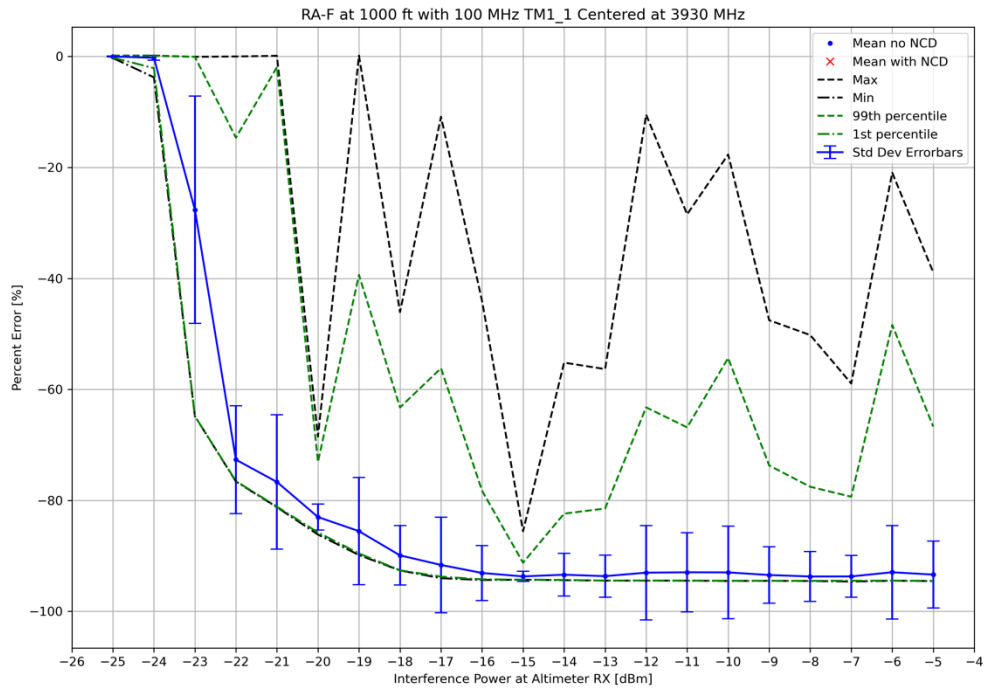


Figure 3-44: UC1 RA-F 1000' AGL Statistics with TM1.1 at 3930 MHz – Zoomed Out

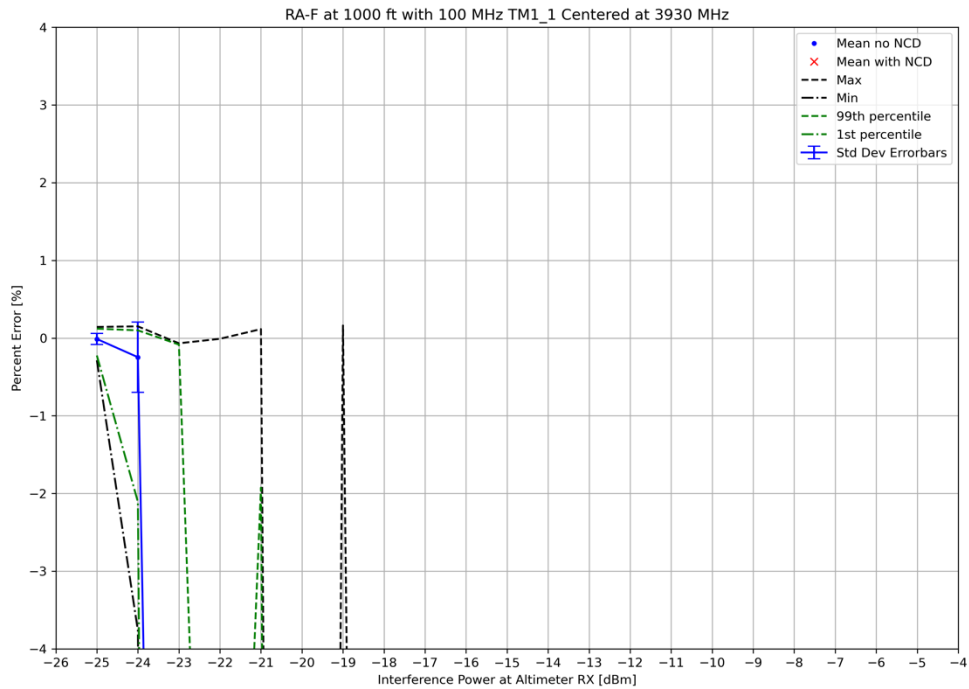


Figure 3-45: UC1 RA-F 1000' AGL Statistics with TM1.1 at 3930 MHz – Zoomed In

3.2.2.3 Altimeter L

Table 3-12: UC1 RA-L 1000' AGL OOB Fundamental Emissions Break Point Summary

Center Frequency	Plot	Comments
3750 MHz	Time History Figure 3-46	Shows magnitude of change in measured height over time for increasing interference power levels.
	Statistics Figure 3-47	No break observed.
3850 MHz	Time History Figure 3-48	Shows magnitude of change in measured height over time for increasing interference power levels.
	Statistics Figure 3-49	No break observed.
3930 MHz	Time History Figure 3-50	Shows magnitude of change in measured height over time for increasing interference power levels.
	Statistics Figure 3-51	No break observed.

Center Frequency = 3750 MHz

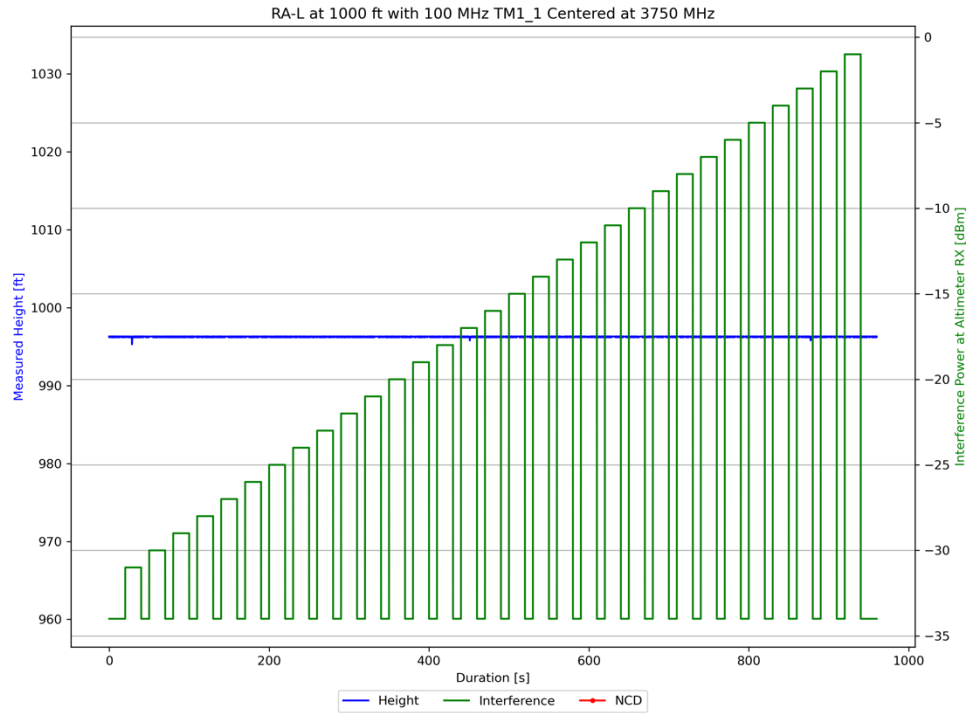


Figure 3-46: UC1 RA-L 1000' AGL Time History with TM1.1 at 3750 MHz

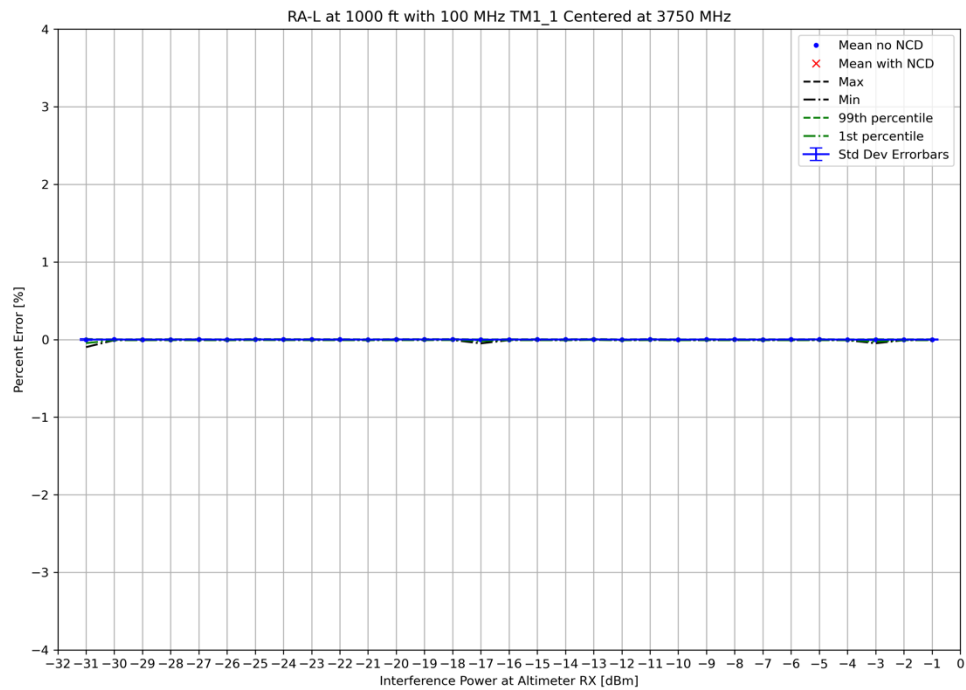


Figure 3-47: UC1 RA-L 1000' AGL Statistics with TM1.1 at 3750 MHz

Center Frequency = 3850 MHz

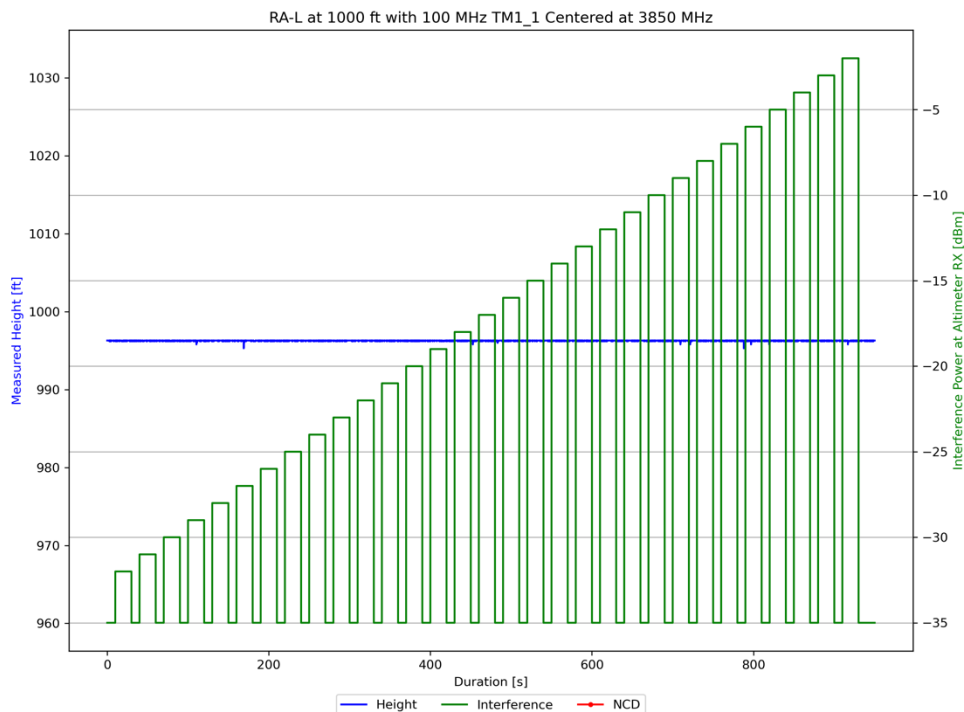


Figure 3-48: UC1 RA-L 1000' AGL Time History with TM1.1 at 3850 MHz

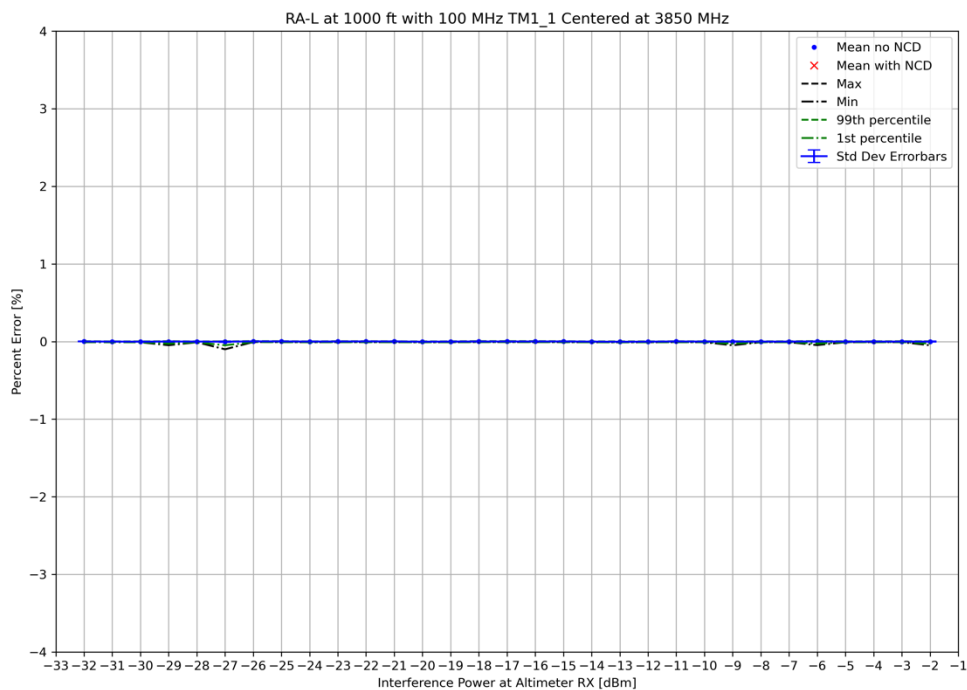


Figure 3-49: UC1 RA-L 1000' AGL Statistics with TM1.1 at 3850 MHz

Center Frequency = 3930 MHz

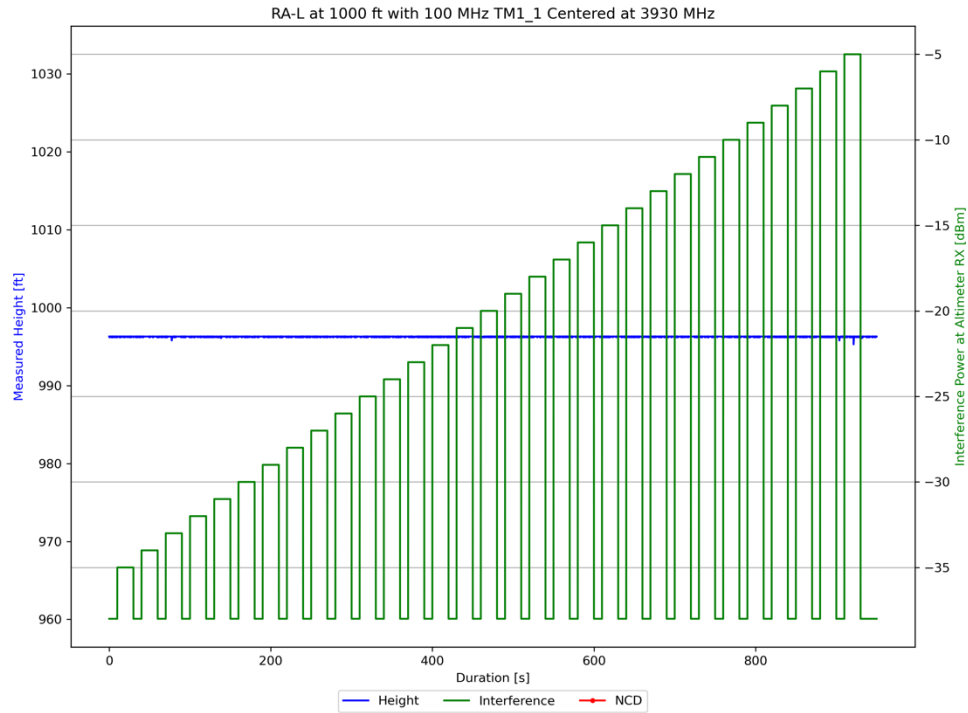


Figure 3-50: UC1 RA-L 1000' AGL Time History with TM1.1 at 3930 MHz

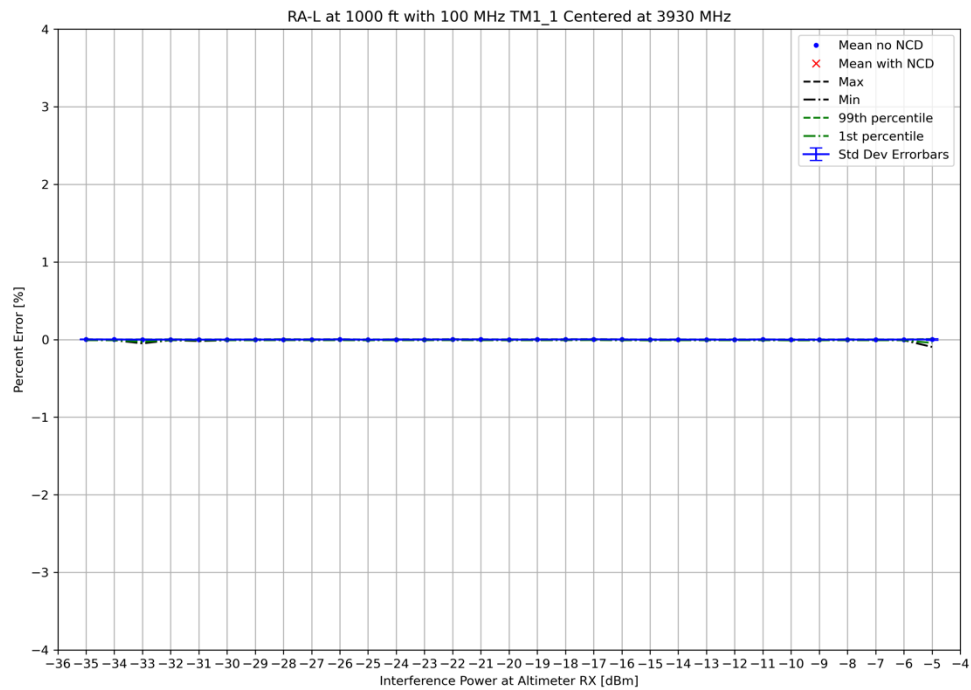


Figure 3-51: UC1 RA-L 1000' AGL Statistics with TM1.1 at 3930 MHz

3.2.2.4 Altimeter T

Table 3-13: UC1 RA-T 1000' AGL OOB Fundamental Emissions Break Point Summary

Center Frequency	Plot	Comments
3750 MHz	Time History Figure 3-52	Shows magnitude of change in measured height over time for increasing interference power levels.
	Statistics Figure 3-53	No break observed.
3850 MHz	Time History Figure 3-54	Shows magnitude of change in measured height over time for increasing interference power levels.
	Statistics Figure 3-55	No break observed.
3930 MHz	Time History Figure 3-56	Shows magnitude of change in measured height over time for increasing interference power levels.
	Statistics Figure 3-57	No break observed.

Center Frequency = 3750 MHz

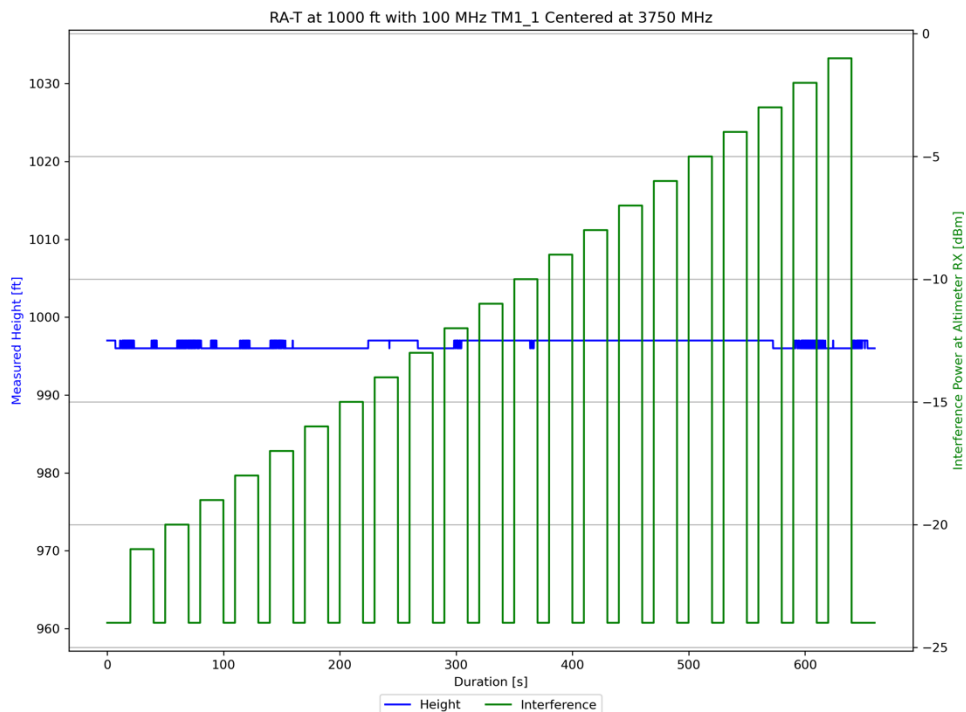


Figure 3-52: UC1 RA-T 1000' AGL Time History with TM1.1 at 3750 MHz

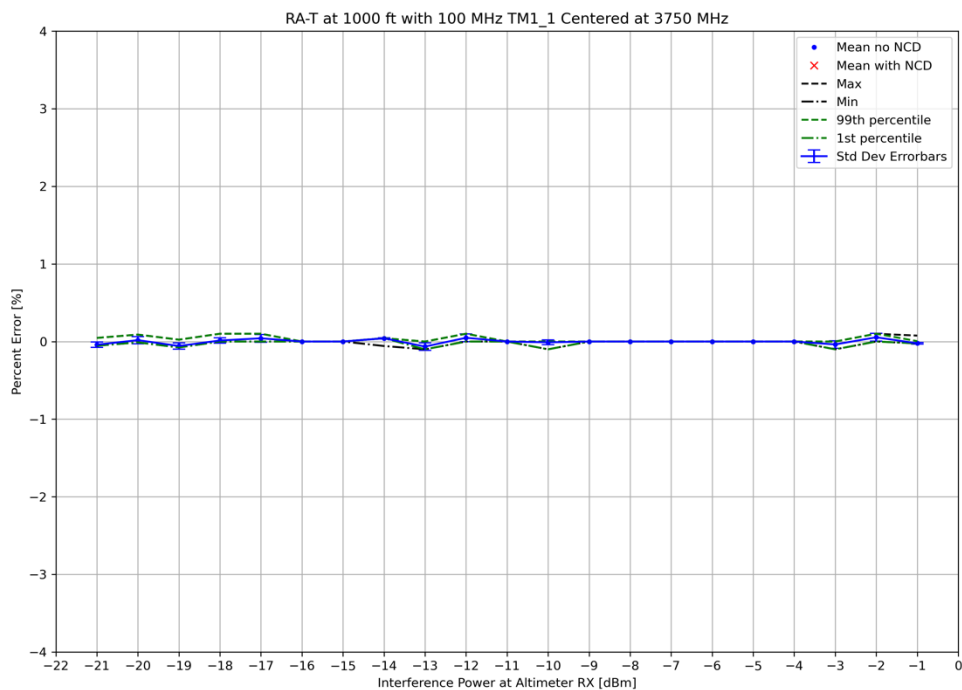


Figure 3-53: UC1 RA-T 1000' AGL Statistics with TM1.1 at 3750 MHz

Center Frequency = 3850 MHz

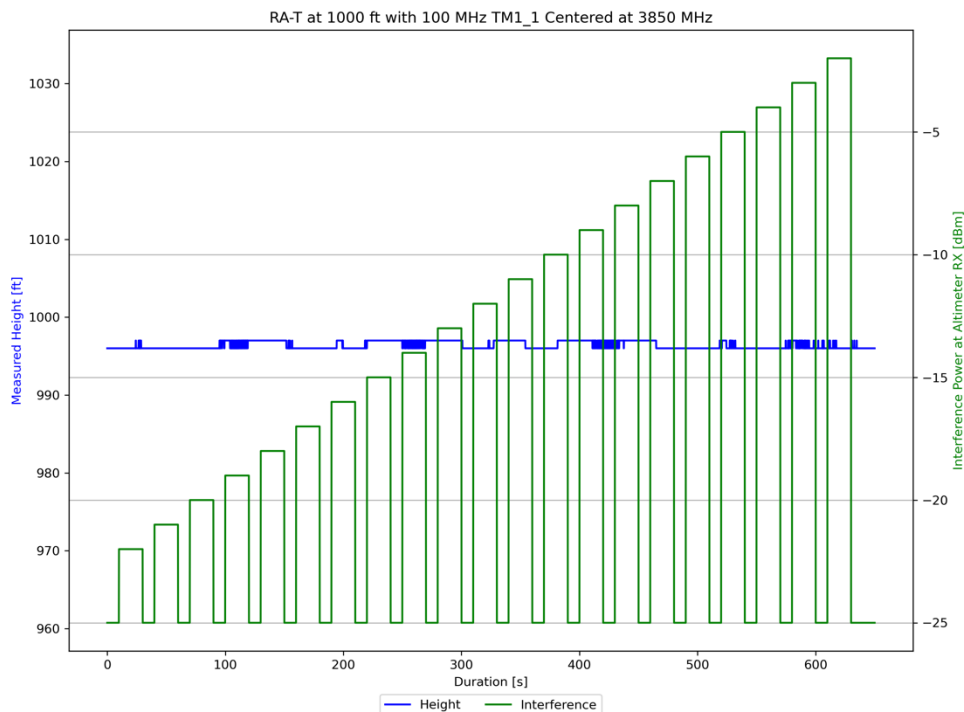


Figure 3-54: UC1 RA-T 1000' AGL Time History with TM1.1 at 3850 MHz

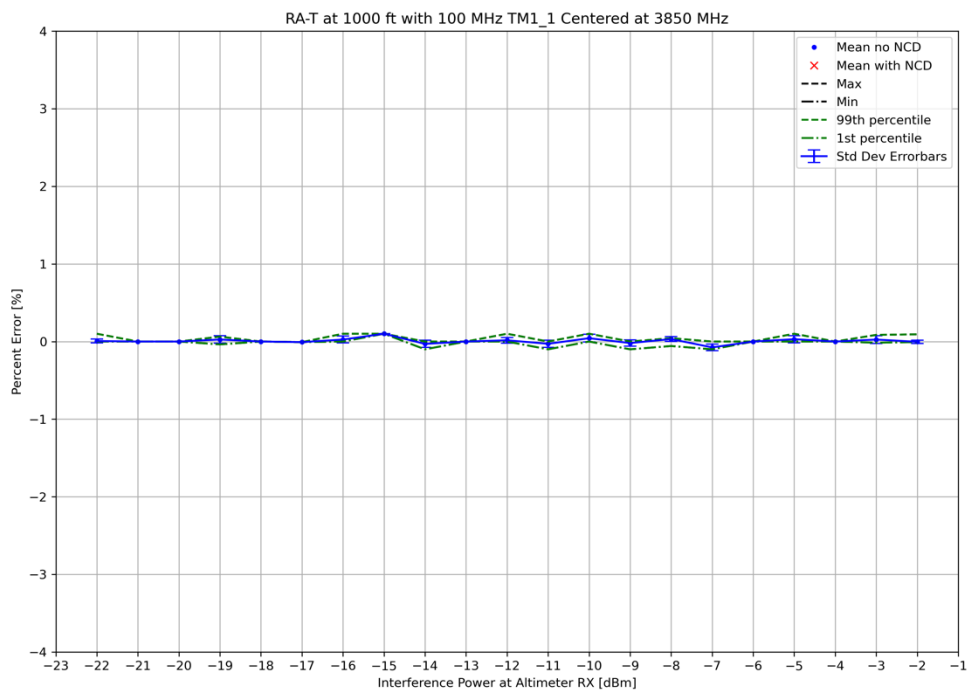


Figure 3-55: UC1 RA-T 1000' AGL Statistics with TM1.1 at 3850 MHz

Center Frequency = 3930 MHz

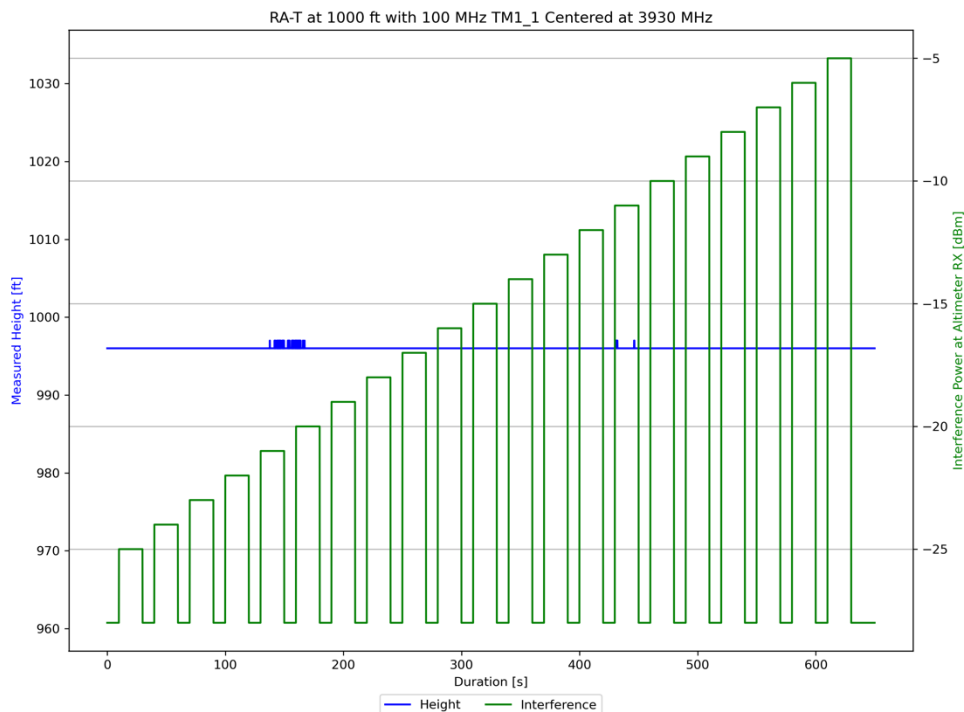


Figure 3-56: UC1 RA-T 1000' AGL Time History with TM1.1 at 3930 MHz

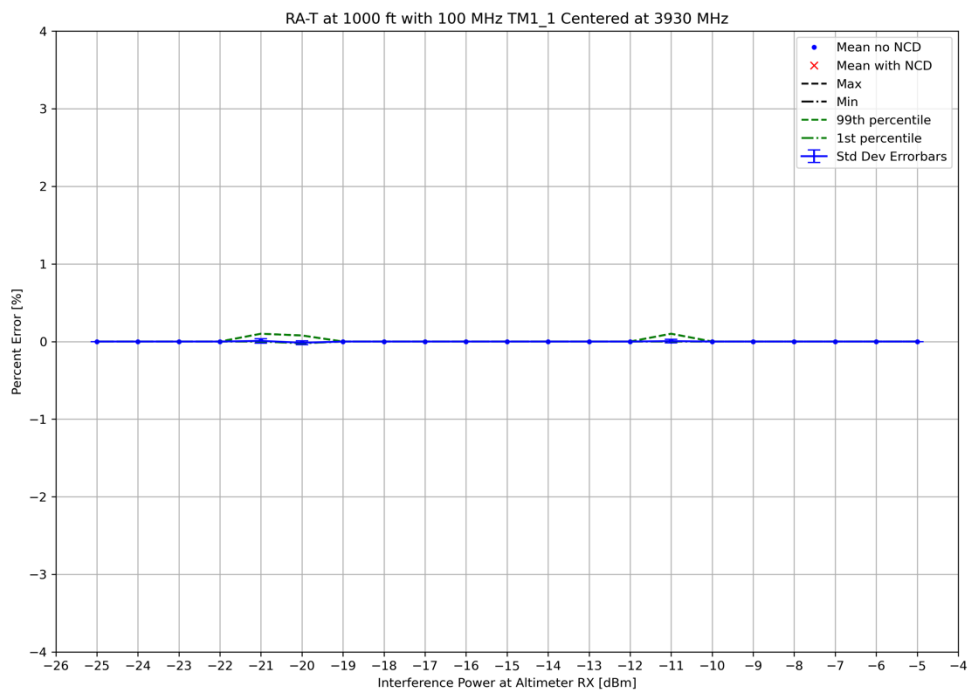


Figure 3-57: UC1 RA-T 1000' AGL Statistics with TM1.1 at 3930 MHz

3.2.2.5 Altimeter X

Table 3-14: UC1 RA-X 1000' AGL OOB Fundamental Emissions Break Point Summary

Center Frequency	Plot	Comments
3750 MHz	Time History Figure 3-58	Shows magnitude of change in measured height over time for increasing interference power levels.
	Statistics Figure 3-59	No break observed.
3850 MHz	Time History Figure 3-60 Figure 3-61	Show the magnitude of change in measured height over time for increasing interference power levels for both full vertical and magnified vertical scales.
	Statistics Figure 3-62 Figure 3-63	Mean error exceeds the $\pm 0.5\%$ criterion threshold at -7 dBm. 1 st percentile measured height is less than the -2% criterion threshold at -7 dBm. An NCD occurs at -2 dBm. The change in the measured height is evident from the zoomed-in time history plot in Figure 3-61 and the mean error is very close to the 0.5% error threshold at -8 dBm. Subject matter experts agreed that in this case engineering judgement should be applied to set the mean break point at -8 dBm.
3930 MHz	Time History Figure 3-64	Shows magnitude of change in measured height over time for increasing interference power levels.
	Statistics Figure 3-65 Figure 3-66	Mean error exceeds the $\pm 0.5\%$ criterion threshold at -14 dBm. 1 st percentile measured height is less than the -2% criterion threshold at -13 dBm. An NCD occurs at -8 dBm.

Center Frequency = 3750 MHz

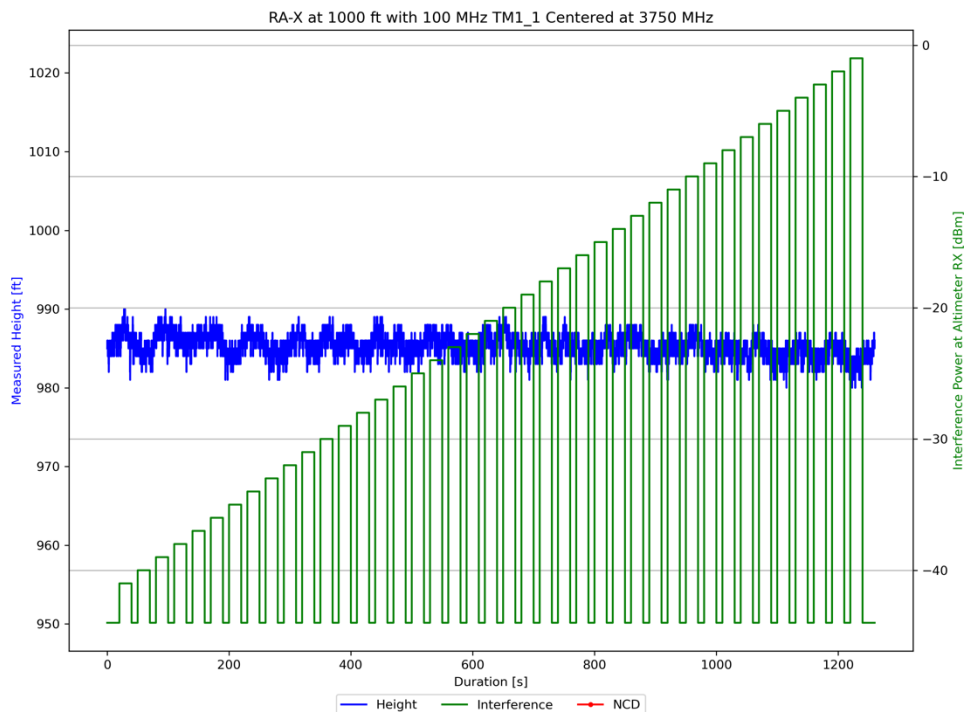


Figure 3-58: UC1 RA-X 1000' AGL Time History with TM1.1 at 3750 MHz

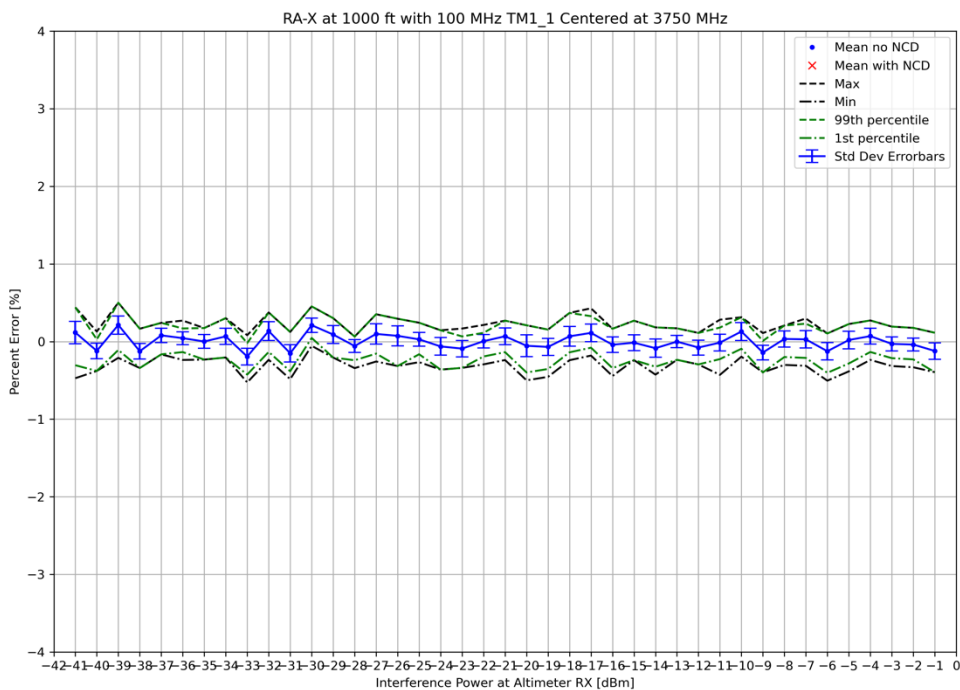


Figure 3-59: UC1 RA-X 1000' AGL Statistics with TM1.1 at 3750 MHz

Center Frequency = 3850 MHz

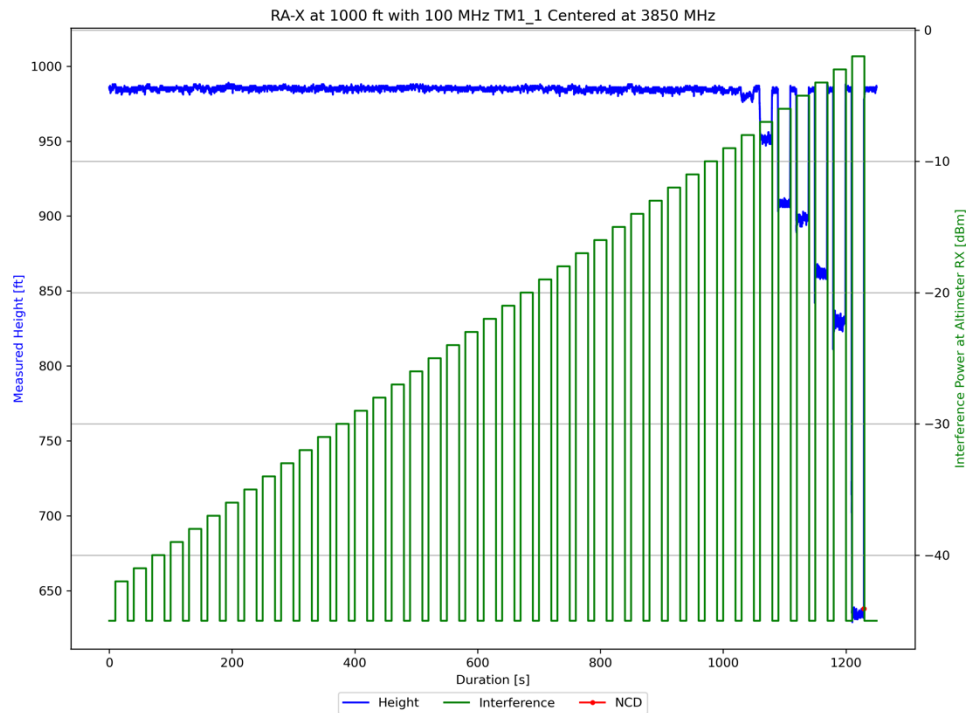


Figure 3-60: UC1 RA-X 1000' AGL Time History with TM1.1 at 3850 MHz

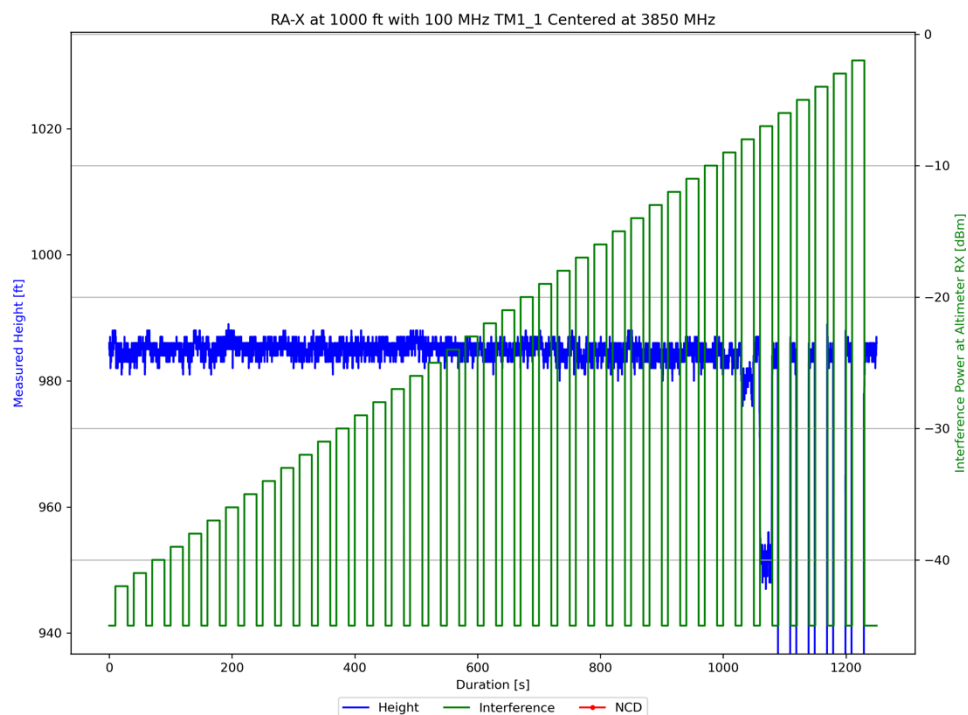


Figure 3-61: UC1 RA-X 1000' AGL Time History with TM1.1 at 3850 MHz – Zoomed In

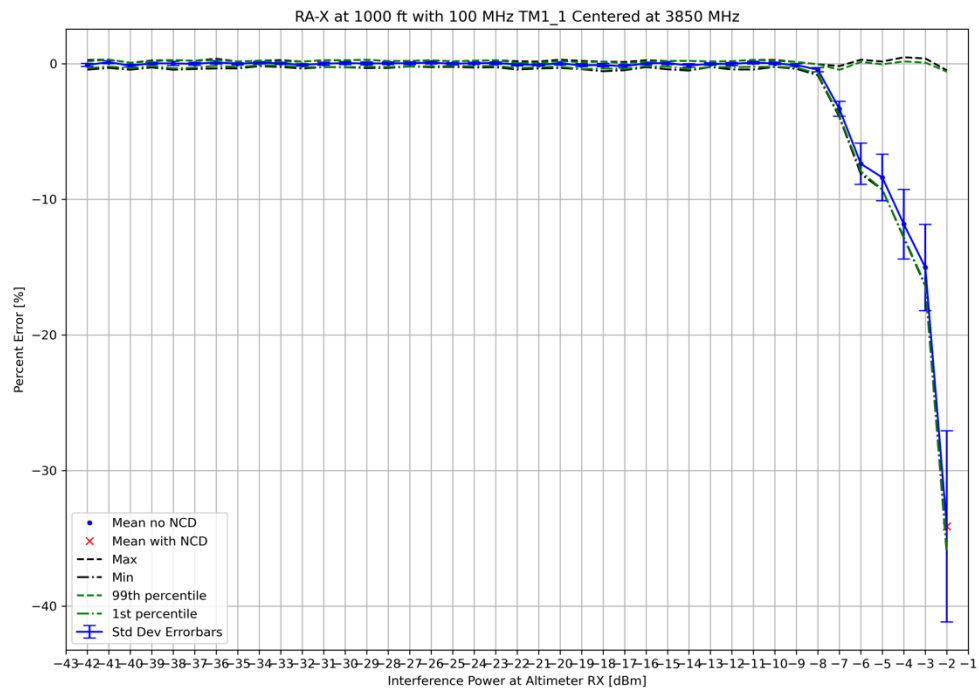


Figure 3-62: UC1 RA-X 1000' AGL Statistics with TM1.1 at 3850 MHz – Zoomed Out

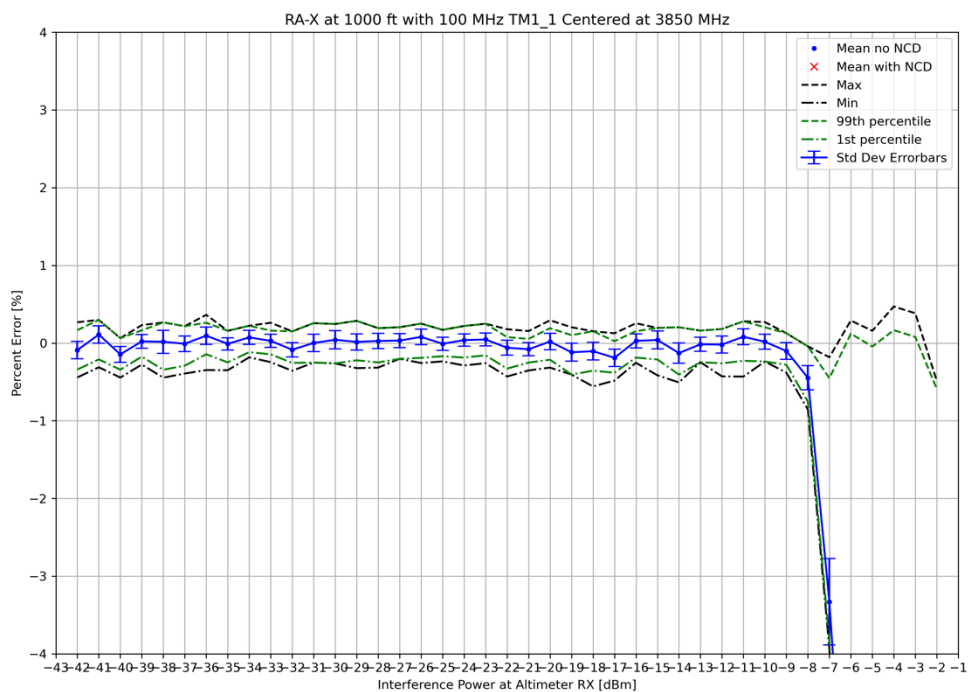


Figure 3-63: UC1 RA-X 1000' AGL Statistics with TM1.1 at 3850 MHz – Zoomed In

Center Frequency = 3930 MHz

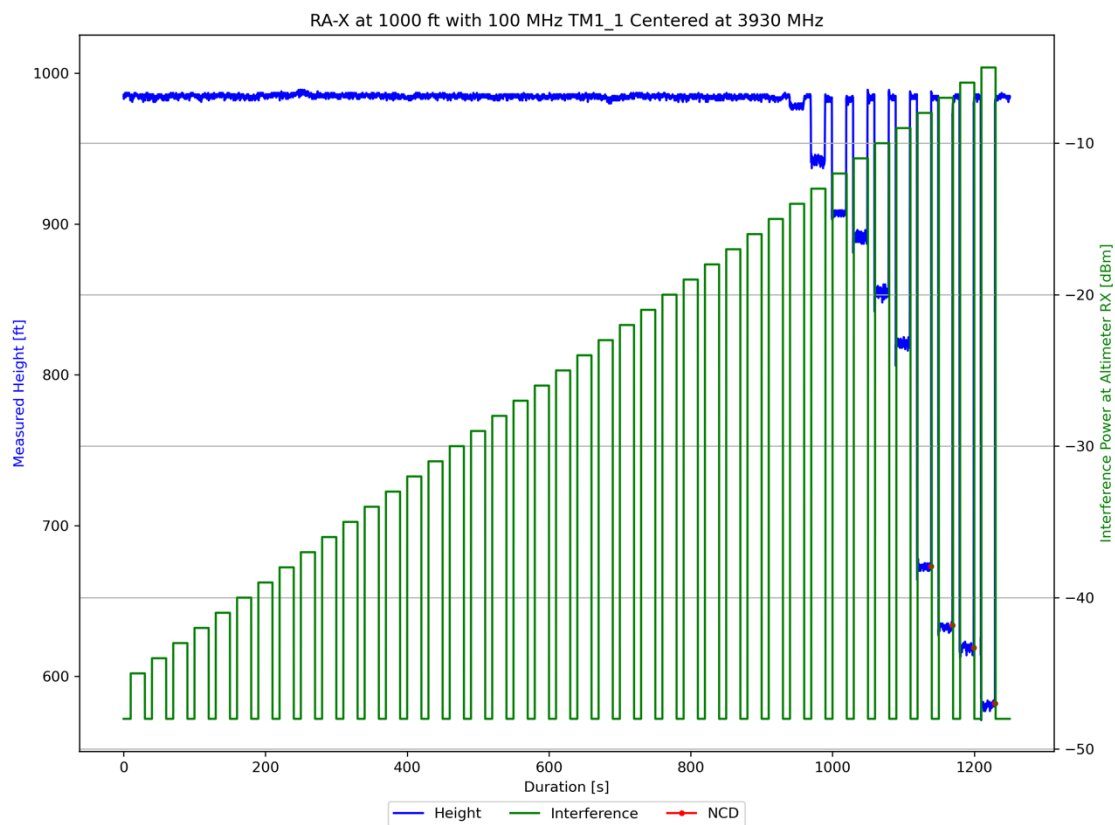


Figure 3-64: UC1 RA-X 1000' AGL Time History with TM1.1 at 3930 MHz

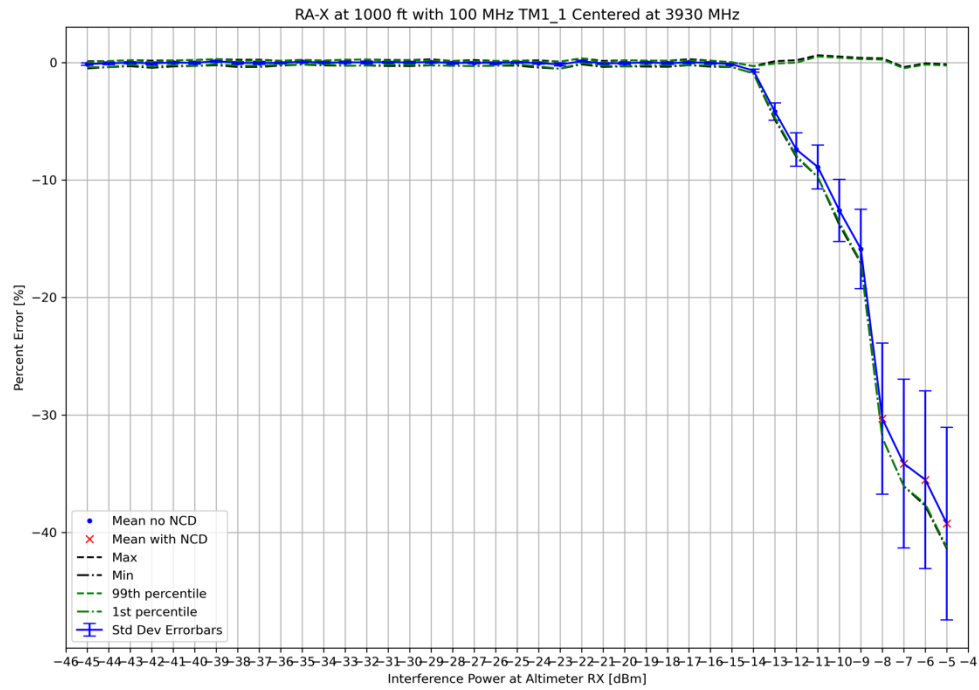


Figure 3-65: UC1 RA-X 1000' AGL Statistics with TM1.1 at 3930 MHz – Zoomed Out

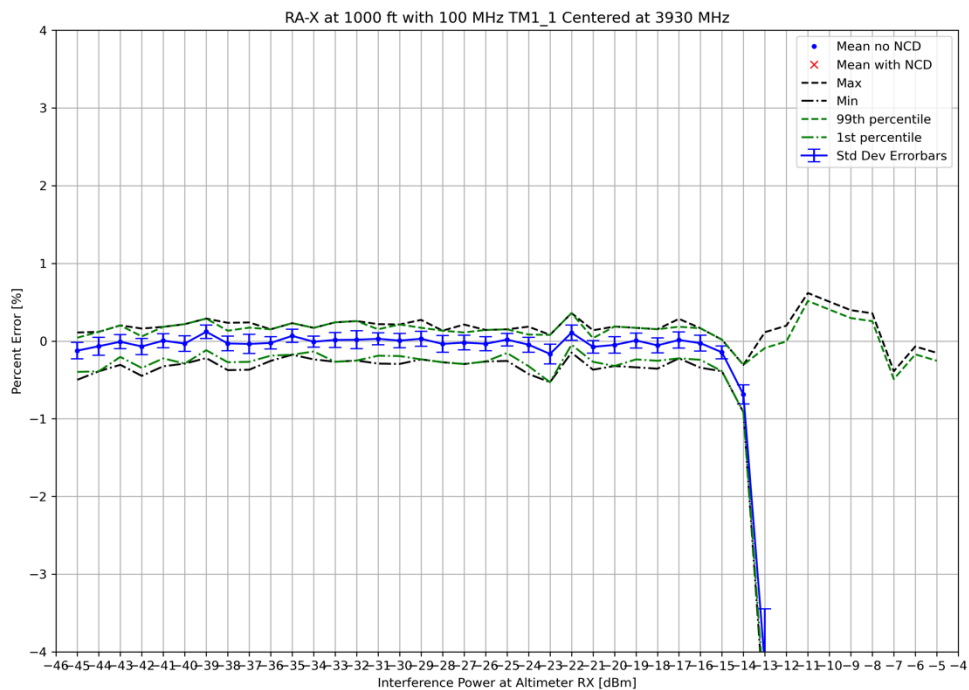


Figure 3-66: UC1 RA-X 1000' AGL Statistics with TM1.1 at 3930 MHz – Zoomed In

3.2.2.6 Altimeter Y

Table 3-15: UC1 RA-Y 1000' AGL OOB Fundamental Emissions Break Point Summary

Center Frequency	Plot	Comments
3750 MHz	Time History Figure 3-67	Shows magnitude of change in measured height over time for increasing interference power levels.
	Statistics Figure 3-68 Figure 3-69	An NCD occurs at -15 dBm. Mean error exceeds the $\pm 0.5\%$ criterion threshold at -15 dBm. 1 st percentile measured height is less than the -2% criterion threshold at -15 dBm.
3850 MHz	Time History Figure 3-70	Shows magnitude of change in measured height over time for increasing interference power levels.
	Statistics Figure 3-71 Figure 3-72	An NCD occurs at -14 dBm. Mean error exceeds the $\pm 0.5\%$ criterion threshold at -14 dBm. 1 st percentile measured height is less than the -2% criterion threshold at -14 dBm.
3930 MHz	Time History Figure 3-73	Shows magnitude of change in measured height over time for increasing interference power levels.
	Statistics Figure 3-74	An NCD occurs at -17 dBm. Mean error exceeds the $\pm 0.5\%$ criterion threshold at -17 dBm. 1 st percentile measured height is less than the -2% criterion threshold at -17 dBm.

Center Frequency = 3750 MHz

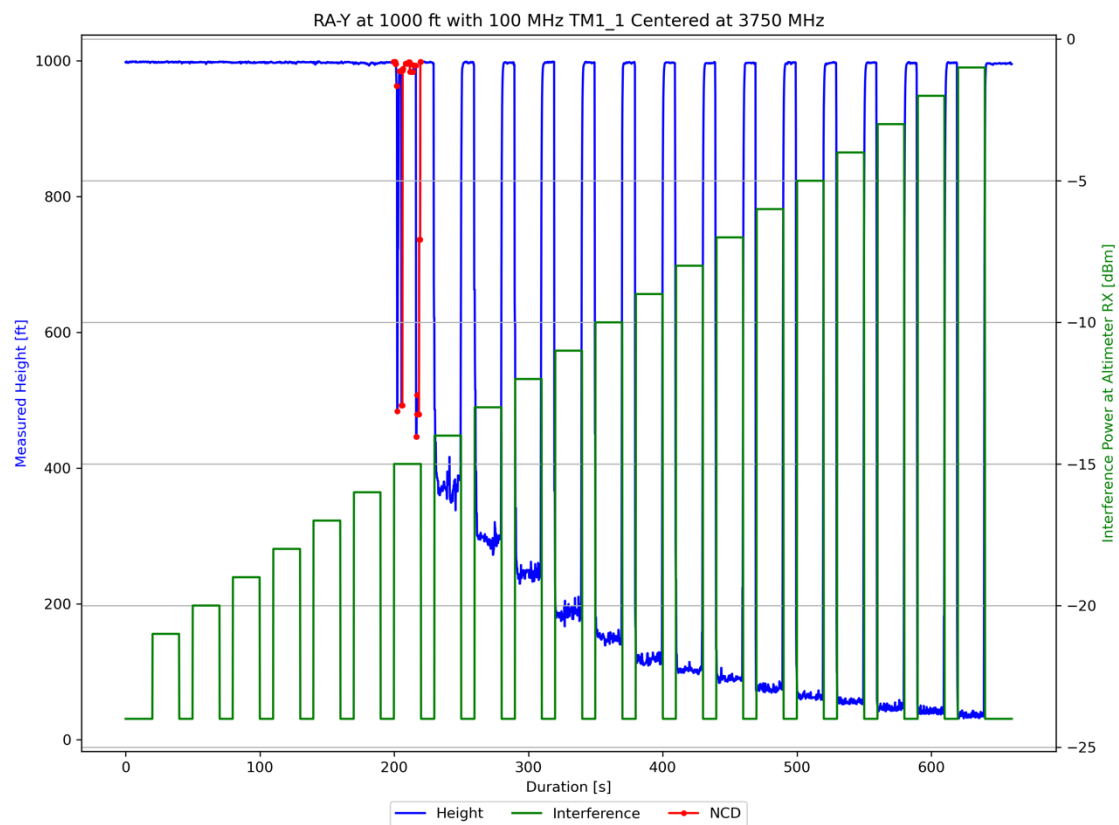


Figure 3-67: UC1 RA-Y 1000' AGL Time History with TM1.1 at 3750 MHz

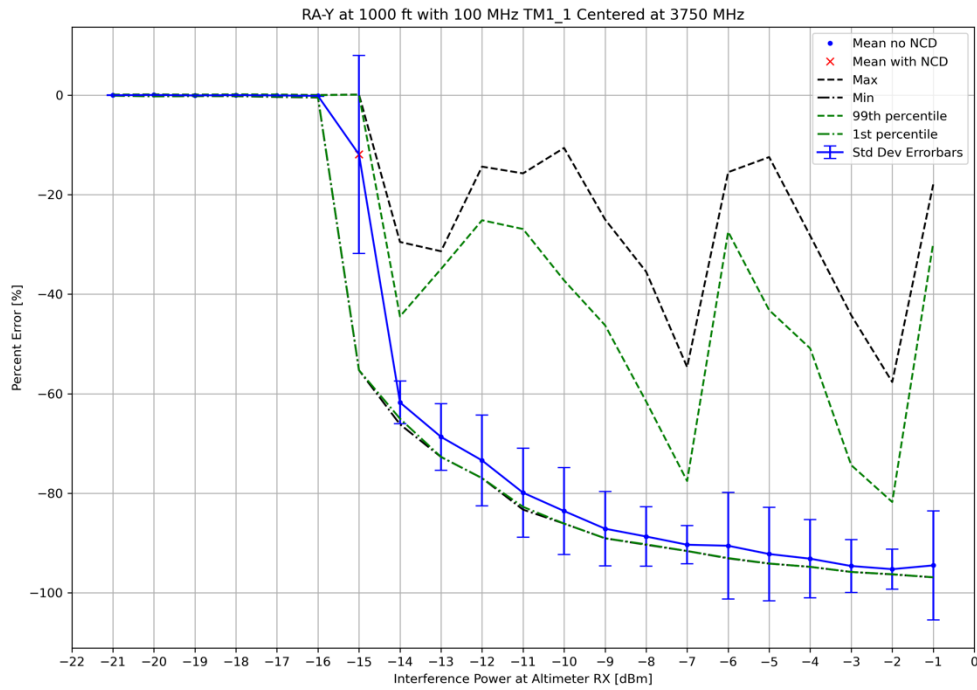


Figure 3-68: UC1 RA-Y 1000' AGL Statistics with TM1.1 at 3750 MHz – Zoomed Out

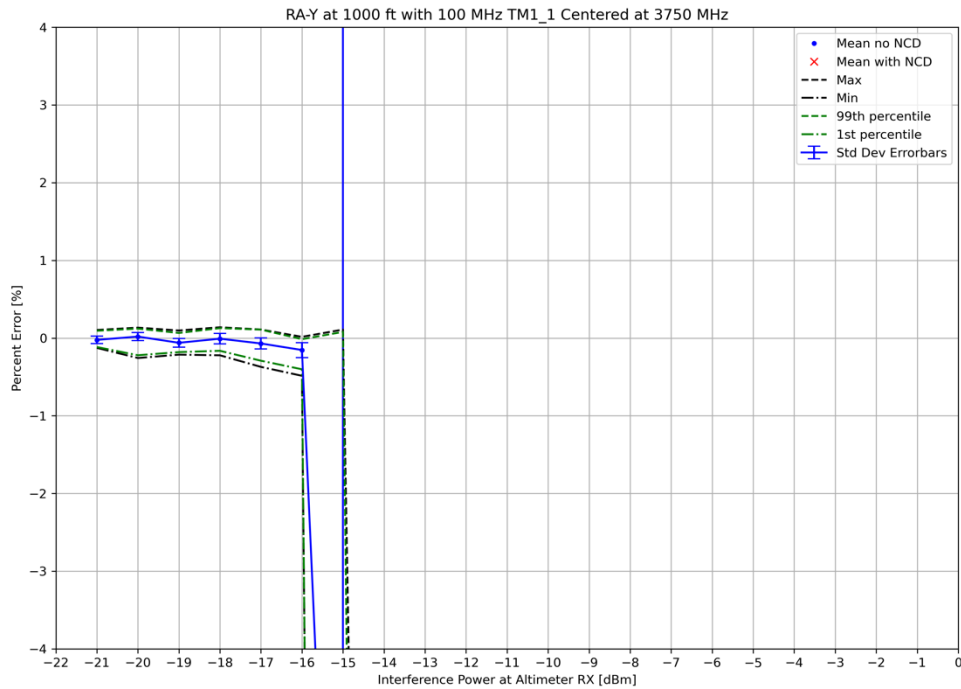


Figure 3-69: UC1 RA-Y 1000' AGL Statistics with TM1.1 at 3750 MHz – Zoomed In

Center Frequency = 3850 MHz

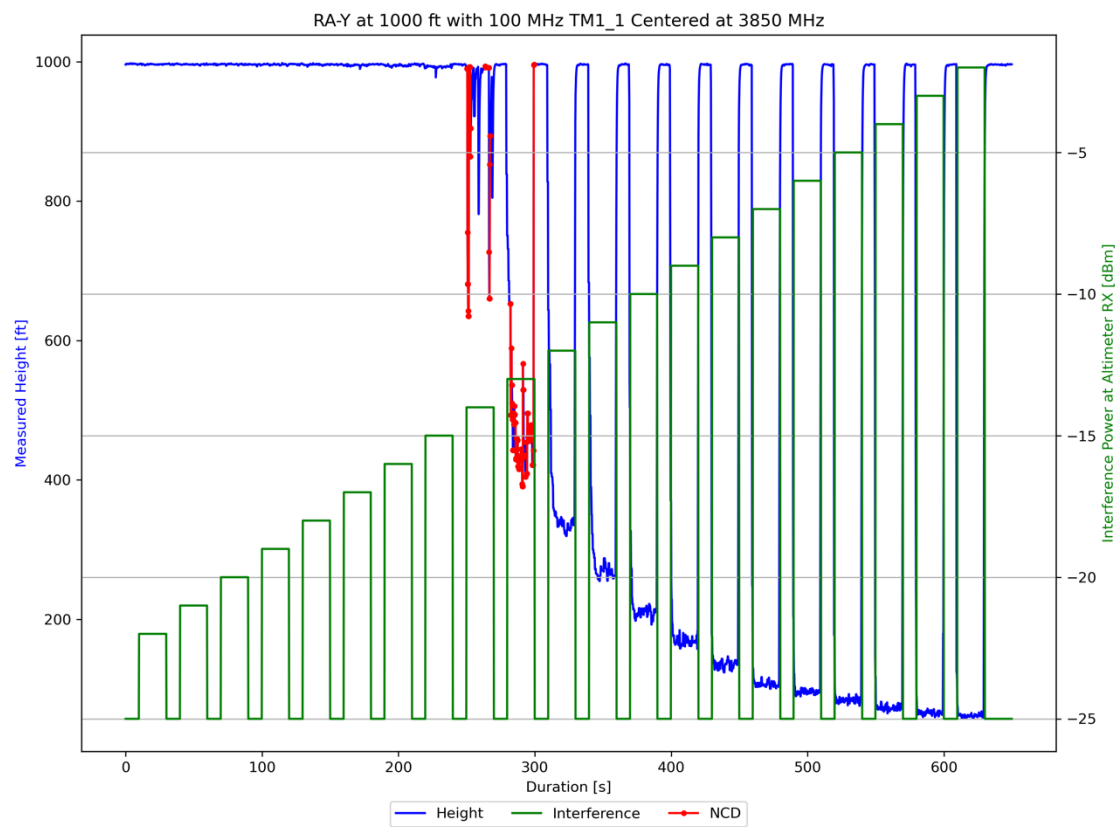


Figure 3-70: UC1 RA-Y 1000' AGL Time History with TM1.1 at 3850 MHz

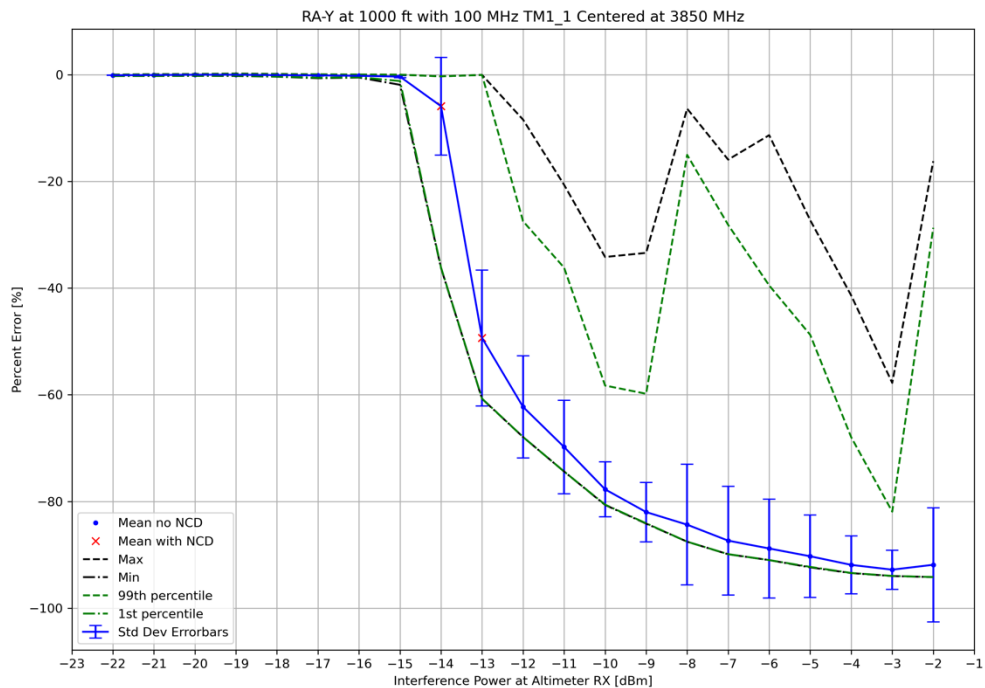


Figure 3-71: UC1 RA-Y 1000' AGL Statistics with TM1.1 at 3850 MHz – Zoomed Out

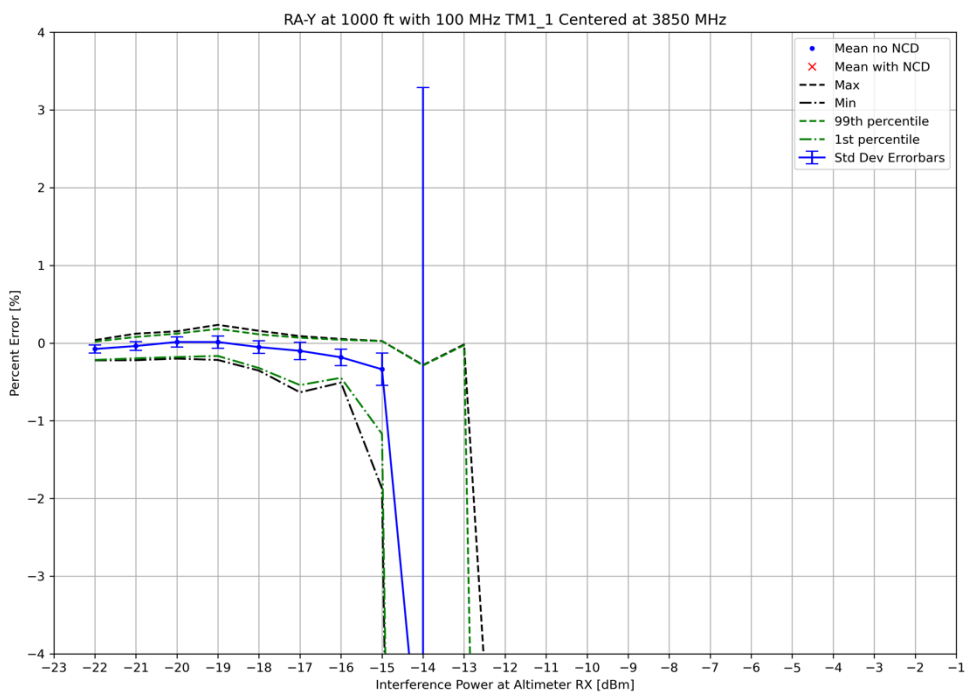


Figure 3-72: UC1 RA-Y 1000' AGL Statistics with TM1.1 at 3850 MHz – Zoomed In

Center Frequency = 3930 MHz

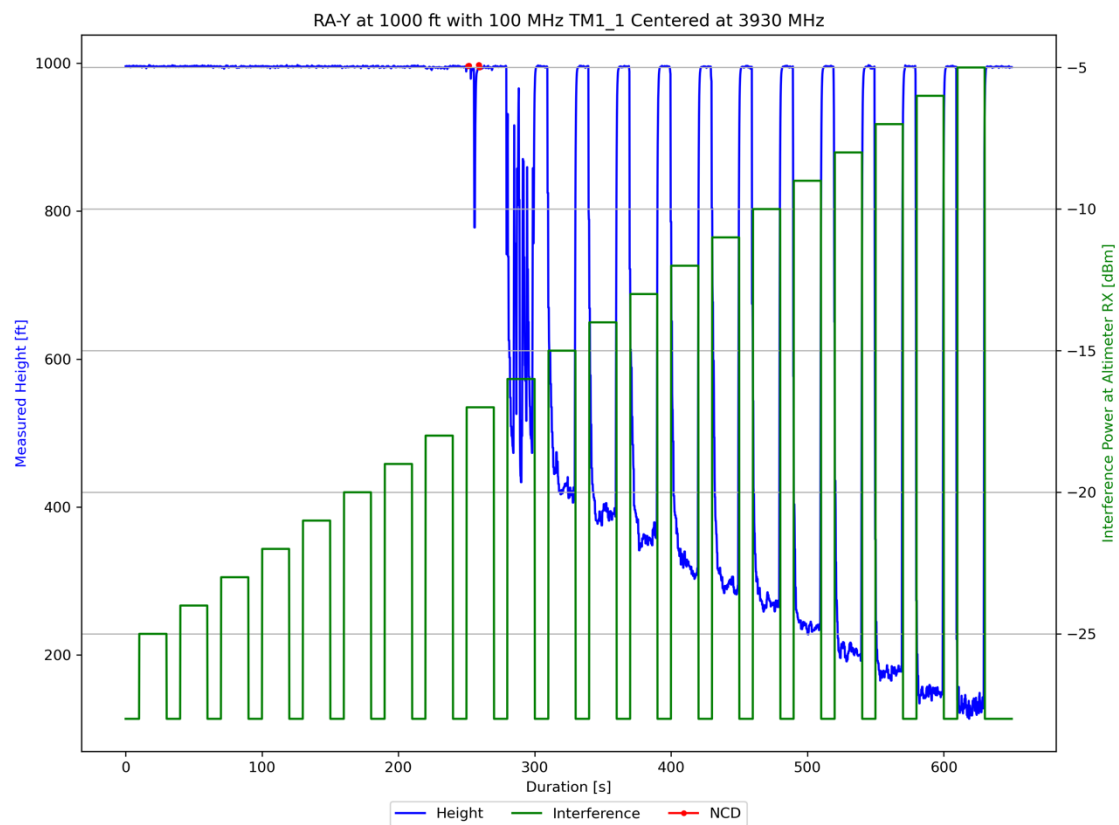


Figure 3-73: UC1 RA-Y 1000' AGL Time History with TM1.1 at 3930 MHz

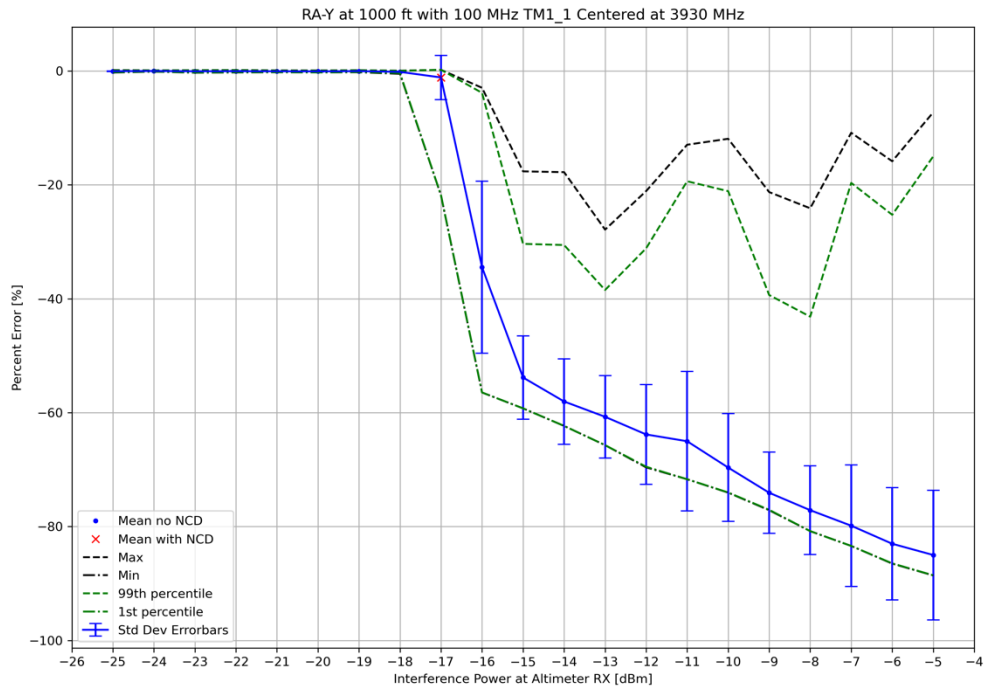


Figure 3-74: UC1 RA-Y 1000' AGL Statistics with TM1.1 at 3930 MHz – Zoomed Out

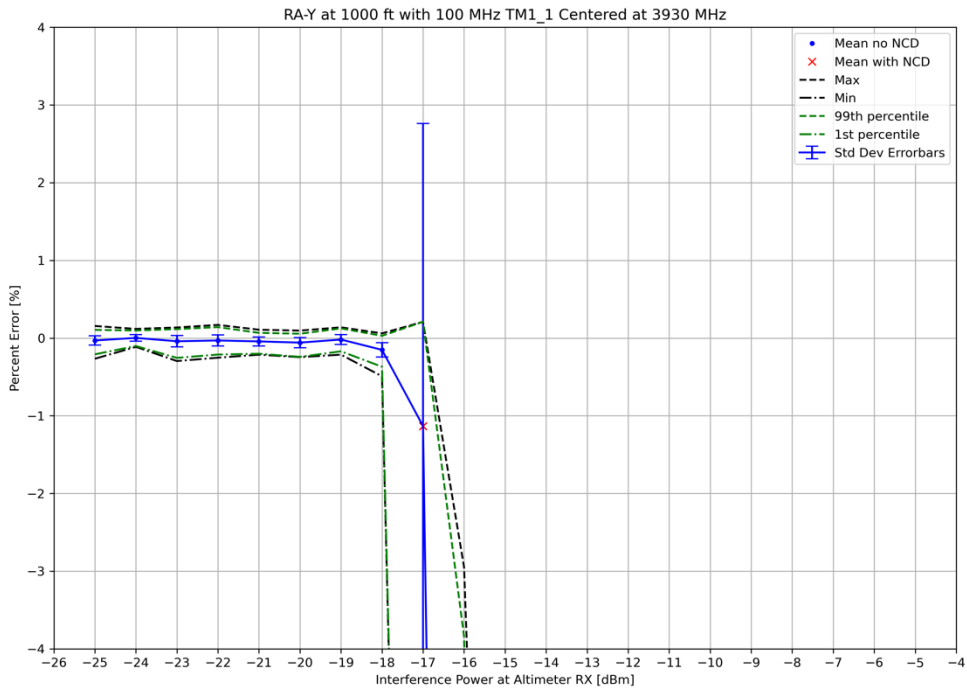


Figure 3-75: UC1 RA-Y 1000' AGL Statistics with TM1.1 at 3930 MHz – Zoomed In